# Resiliency & Microgrids Working Group

## Microgrid Islanding Study

Resiliency and Microgrids Team, Energy Division

August 27, 2021

California Public
Utilities Commission

# WebEx and Call-In Information

**Join by Computer:**

https://cpuc.webex.com/cpuc/onstage/g.php?MTID=edd9b2f18ff15d8b0826fac5ce658e0fd

Event Password: RMWG (case sensitive)

Meeting Number: 146 795 6934

**Join by Phone:**

- Please register using WebEx link to view phone number.

(Staff recommends using your computer's audio if possible.)

**Notes:**

- Today's presentations are available in the meeting invite (follow link above) and will be available shortly after the meeting on https://www.cpuc.ca.gov/resiliencyandmicrogrids.

- The meeting will not be recorded. There will not be meeting minutes.

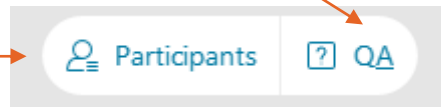
# WebEx Logistics

- All attendees are muted on entry by default.
- Questions can be asked verbally during Q&A segments using the "raise hand" function.
  - The host will unmute you during Q&A portions [and you will have a maximum of 2 minutes to ask your question].
  - Please lower your hand after you've asked your question by clicking on the "raise hand" again.
  - If you have another question, please "re-raise your hand" by clicking on the "raise hand" button twice.
- Questions can also be written in the Q&A box and will be answered verbally during Q&A segments.

## WebEx Tip

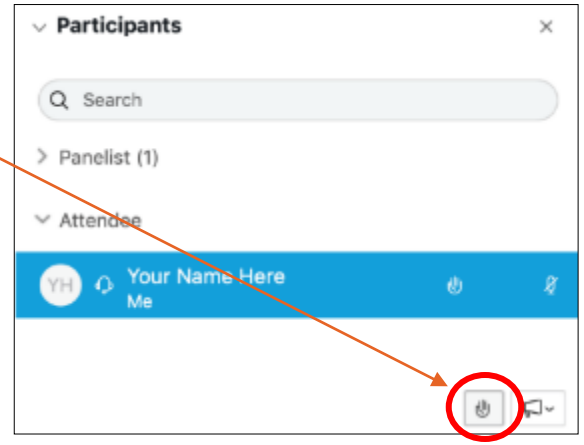
**Access the written Q&A panel here**

**1. Click here to access the attendee list to raise and lower your hand.**



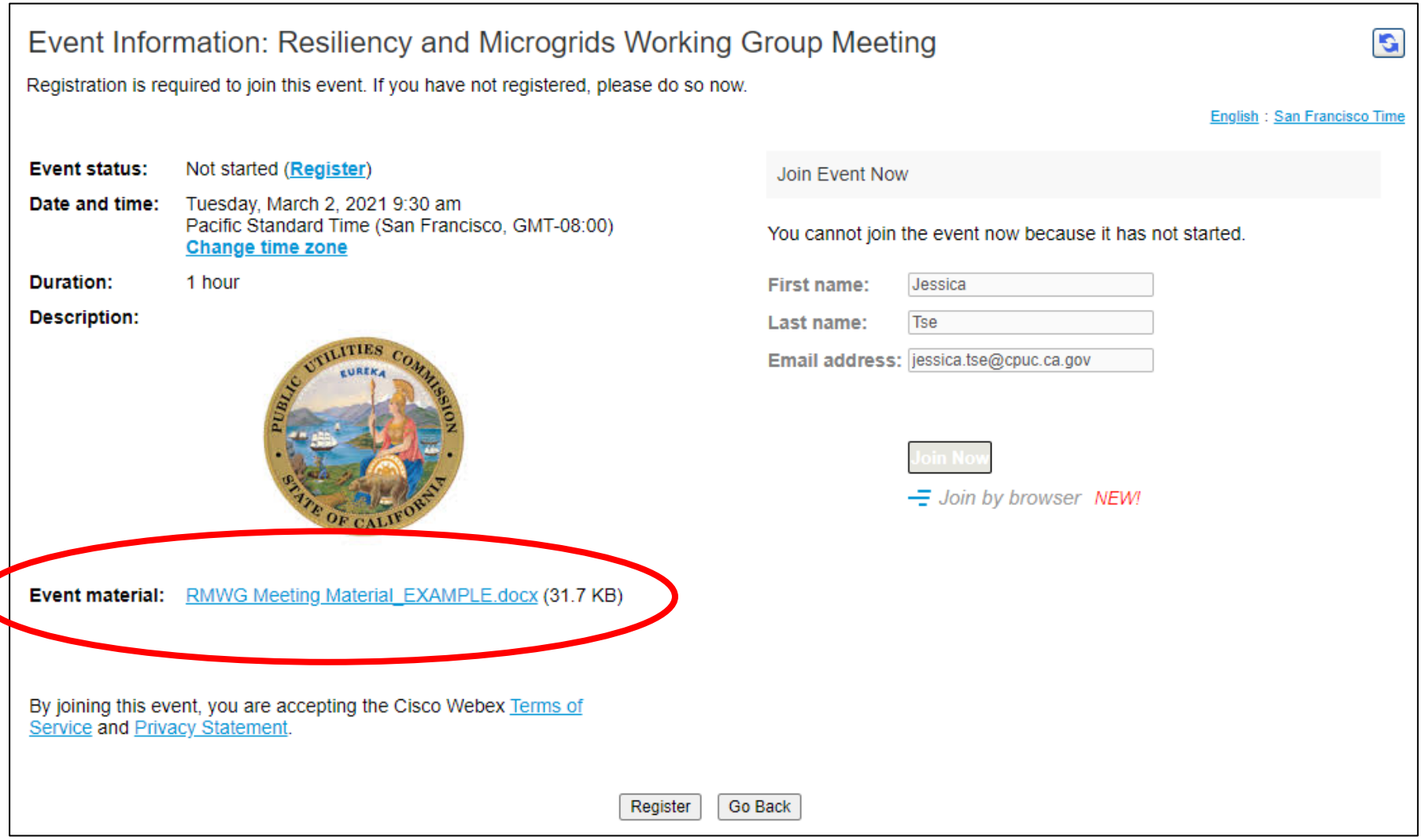

**2. Raise your hand by clicking the hand icon.**

**3. Lower it by clicking again.**




**Access your meeting audio settings here**

# WebEx Event Materials



# Preliminary Resiliency & Microgrids Working Group Schedule

| Month | Resiliency and Microgrids Working Group Topics | | | |
|---|---|---|---|---|
| February | Standby Charges | Multi-Property Microgrid Tariff | | |
| March | | | | |
| April | | | | |
| May | | | Value of Resiliency | |
| June | | | | |
| July | | | | |
| August | | | | Microgrid Interconnection |
| September | | | | |
| October | | | | |
| November | Customer-Facing Microgrid Tariff Revisit | | | |
| December | | | | |
| January | | | | |
| February | | | | |

**Interconnection:** Working group participants will discuss interconnection and related issues as they specifically relate to microgrids. Topics will include interconnection requirements for grid-connected mode microgrid operations, controls, communications, and islanded mode microgrid operations where interconnection requirements are not applicable.

# Agenda

**I. Introduction** *(CPUC Staff)* **2:15p – 2:20p**

- WebEx logistics, agenda review

**II. Recap of Prior Meeting** *(Patrick Saxton, CPUC)* **2:20p – 2:30p**

**III. Microgrid Islanding Study** *(Nikky Avila and Mike Jensen, PG&E)* **2:30p – 3:30p**

- Presentation
- Q&A

**IV. Selective De-energization Within a Microgrid Island** **3:30p – 4:25p**
*(Patrick Saxton, CPUC)*

- Discussion

**V. Closing Remarks, Adjourn** *(CPUC Staff)* **4:25p – 4:30p**

- Provide information on the next meeting

# Recap of Prior Meeting

# Recap of Prior Meeting

- Written suggestions to patrick.saxton@cpcu.ca.gov
- Update on DC metering standards
  - Incorporate ANSI C12.32 DC metering standard into Rule 21?
- Definitions/glossary of microgrid terminology may be helpful
  - Make this a formal recommendation?
- Did not identify microgrid specific interconnection issues for single premise microgrids
  - Crossing public street with private wires – Taking offline
  - Any other issues?

# Recap of Prior Meeting

- Develop specifications for microgrid controllers
  - Seeming agreement this should be a formal recommendation
- "Single facility" type interconnection application for microgrids
  - Not much interest from non-utility participants
  - May be logistically challenging for utilities
- Concerns about interconnection of front-of-meter DERs as related to Microgrids Incentive Program
  - Green Power Institute will present at next working group meeting
- Other items?

# DER Action Plan 2.0 – Track 3 Market Integration

- Workshop was August 26, 2021
- Draft action plan and presentation at https://www.cpuc.ca.gov/about-cpuc/divisions/energy-division/der-action-plan
- Send comments to DERActionPlan@cpuc.ca.gov
  - Due October 8, 2021
  - Limited to15 pages

# DER Action Plan 2.0 – Track 3 Market Integration

- Wholesale Market Integration of Exporting BTM DERs:
  - Vision Element 3D – Rule 21 interconnection tariffs are reviewed to address barriers and resolve questions of whether, and if so how, BTM DERs can export to the wholesale grid, and the CPUC, CAISO, and CEC resolve questions of whether and how exporting DERs should receive compensation and participate in wholesale markets.
  - Action Element 3D – Not yet identified. What action elements can help achieve Vision Element 3D?

# DER Action Plan 2.0 – Track 3 Market Integration

- Wholesale Market Integration of FTM DERs:
  - Vision Element 3F – Wholesale Distribution Tariffs (WDTs) for interconnection of DERs to the wholesale grid allow for reasonable cost recovery from DERs seeking interconnection based on cost causation principles while providing those resources with full access to wholesale markets.
  - Action Element 3F: The CPUC participates in FERC proceedings and rulemakings related to WDTs for interconnection of DERs to the wholesale grid to represent the interests of California rate-payers and state energy and climate goals affected by FERC policy.

# Today's Topic – Microgrid Islanding Study

- Single premise microgrid
  - Does not apply – All resources are on customer-side
  - Safety and stability are responsibility of microgrid operator
- Multi-property microgrid utilizing utility distribution grid during islanded operating mode
  - Operating conditions substantially different than those distribution grid designed for
  - Safety and stability not studied in interconnection process
  - Safety and stability of the distribution grid are the utility's responsibility

# Microgrid Islanding Study (MIS) for Community Microgrids

August 27, 2021

# Agenda

| | Agenda Item | Facilitator | Minutes | End Time |
|---|---|---|---|---|
| 1 | Introductions & Safety | Nikky Avila | 5 | 2:35 |
| 2 | Level Setting: “Community Microgrid” & “Microgrid Island Study” | Nikky Avila | 10 | 2:45 |
| 3 | Why is an MIS important?<br>Power Flow and Protection | Mike Jensen | 10 | 2:55 |
| 4 | Elements of the MIS | Nikky Avila | 10 | 3:05 |
| 5 | Q&A | All | 25 | 3:30 |

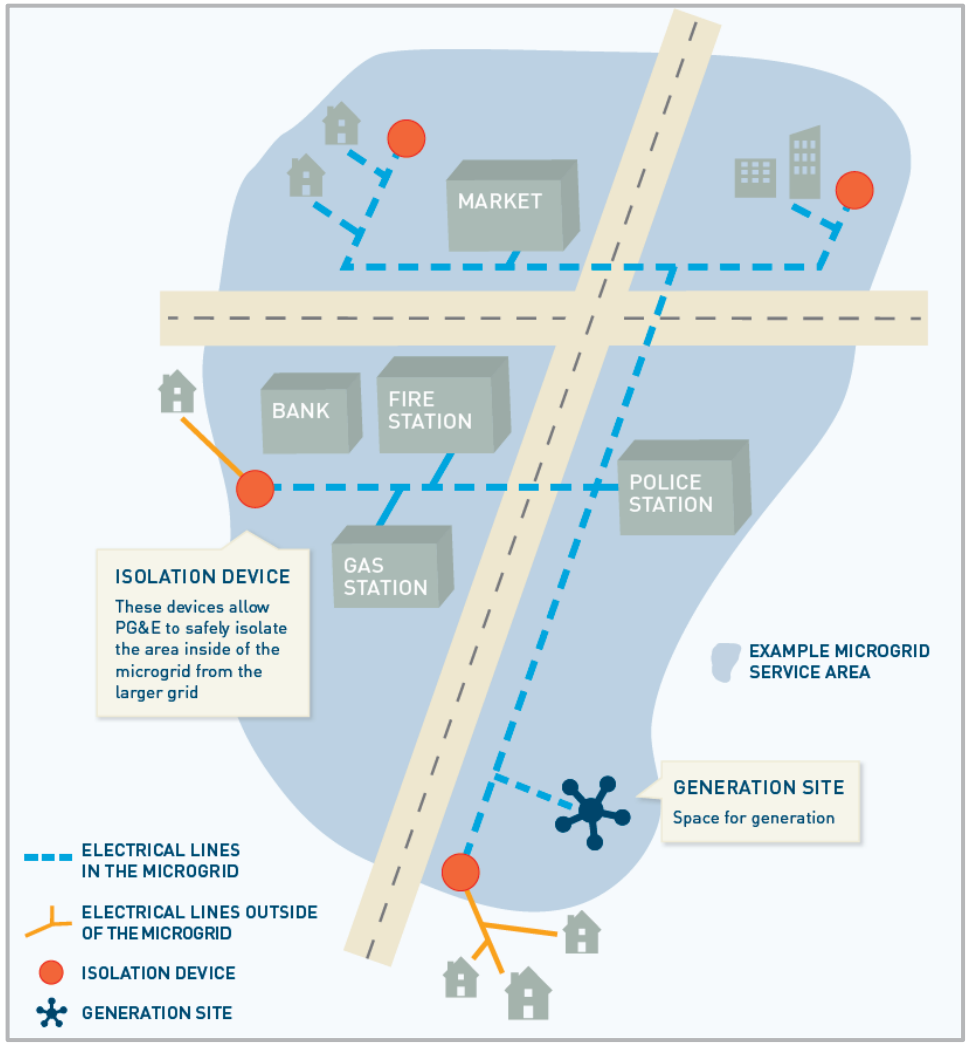
# What is a Community Microgrid?

A **community microgrid** consists of a group of interconnected customers and distributed energy resources within clearly defined electrical boundaries that can disconnect from and reconnect to the grid.

These microgrids are typically designed to serve the portions of communities that include **community resources**, such as:

- Hospitals
- Police and fire stations
- Gas stations and markets

Each community microgrid is uniquely designed by the community to address **their specific goals and needs**. A range of variables will dictate the size of the microgrid, what community services are served and what elements are included in the design.




*The diagram above represents an example layout of a community microgrid. The layout and dimensions are approximate and for illustrative purposes only.*

# Guiding Principles

- **Safety Above All**
- **Meet Customer Needs**
- **Maintain Rate Integrity / Minimize Rate Arbitrage**
- **Maintain Integrity with Existing Tariffs and Processes**
  - Interconnection workflow, WDT, Rule 21, and Rule 2

# Insufficient Existing Processes

- Existing interconnection processes such as Rule 21 and WDT evaluate grid-connected operations

- The studies do not evaluate all safety and operational aspects for community microgrids
  - Islanding of equipment presents a situation of energized equipment under abnormal conditions.
  - These configurations need to be understood to safely and reliably operate

# Standards and Regulations Governing Microgrids

## Relevant Rules and Standards for Microgrids

**System Impact Study**
Rules 2,3,15,16,21
IEEE 1453 or Utility Practice similar to IEEE 1453
UL1741 – Supplement SA
IEEE 519
IEEE Std C62.41.2-2002 or IEEE Std C37.90.1-2002
ANSI C84.1-1995, Range A (IEEE 1547-4.1.1

**Microgrid Island Study**
Rules 2, 21
Microgrid Control Functions: IEEE 2030.7, 2030.8
System Performance Evaluation: IEEE 1547-2018

**Neutral Ground Standards**
IEEE C62.92.4 2014
IEEE C62.92.6 2017

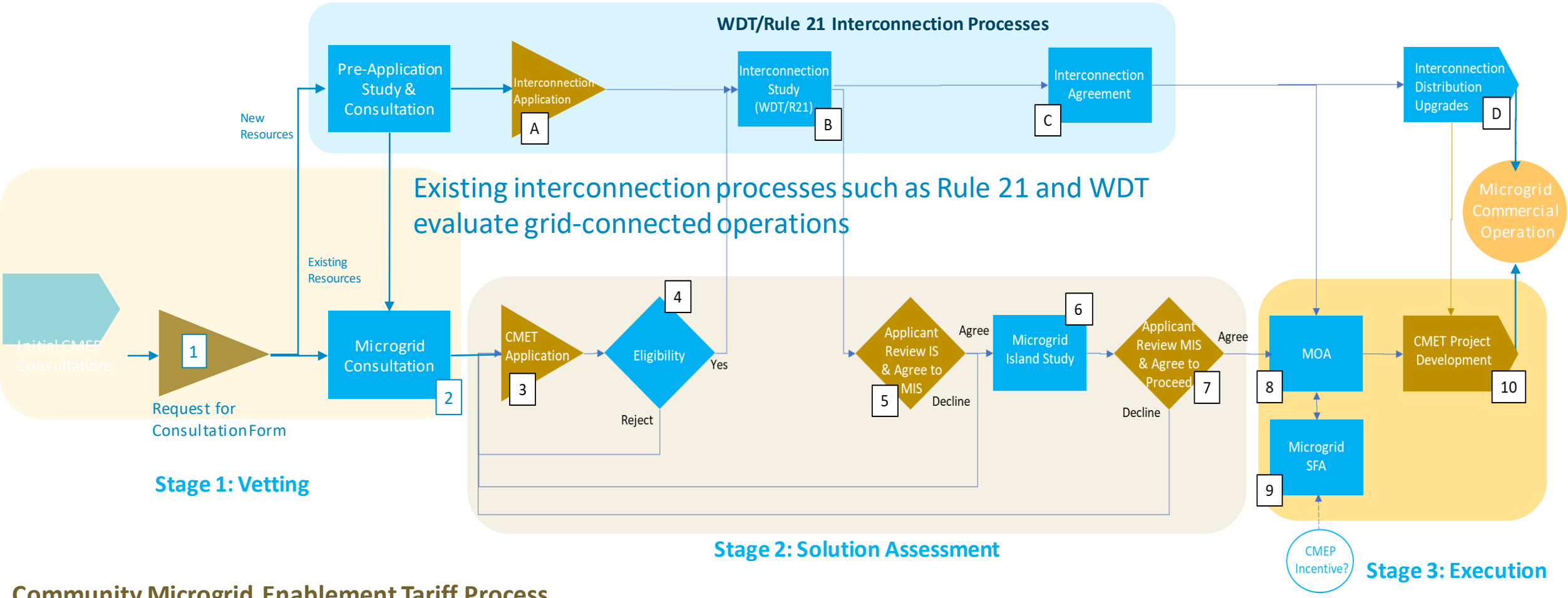
# What is the MIS?

- The Microgrid Island Study (MIS) is a **collection** of design specifications, analyses, procedures, processes, agreements, and documentation needed to upgrade DER(s) to **safely and reliably** form an islanded microgrid system.

- The MIS is **not a substitute** for existing R21/WDT interconnection studies. The MIS is **a separate and additional process** to determine impacts in islanded configuration

# Evaluating islanding operations

- Independent and parallel path to existing interconnection processes




**Community Microgrid Enablement Tariff Process**

# Why do we need an MIS?

1. Microgrid Safety
2. Microgrid Interconnection Protection
3. Microgrid Operating Modes

# Microgrid Protection

**Safety** is of utmost importance when operating and protecting a microgrid, just as it is with a traditional utility operated grid.

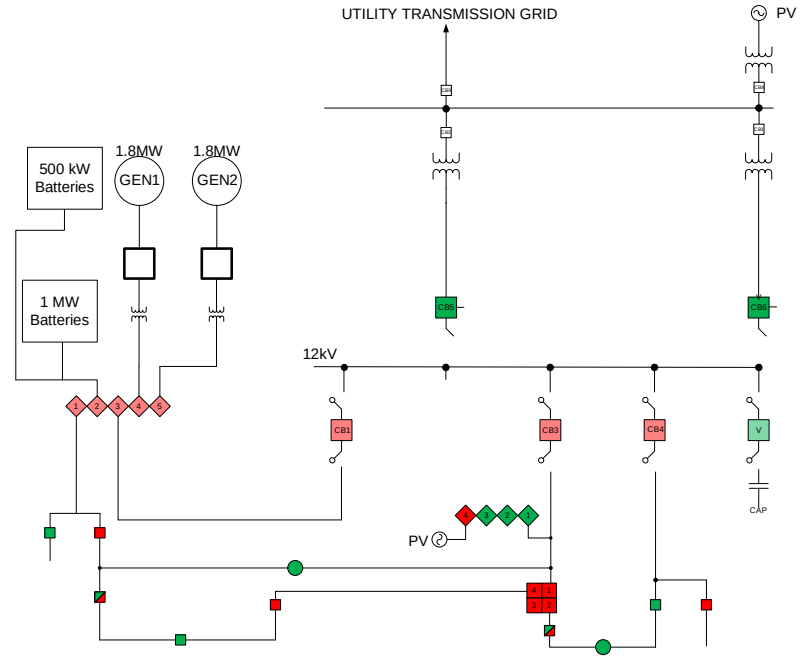
- Faulted conditions shall be detected and isolated.
- Sources of generation shall be removed from faulted circuit segments
- The protection study will determine the settings and protection devices required to detect and trip for faulted conditions.

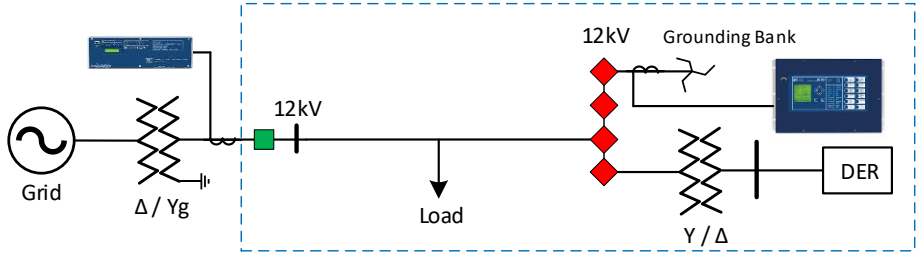
# Microgrid Operating Modes

- Protection systems are typically designed to operate utilizing the traditional utility model of a robust grid as a source feeding customer load. Microgrids introduce new paradigms with respect to a more dynamic system topology, which can change states or “modes”:

- **Grid Following – Microgrid Operates in Parallel with Utility Grid**
  - Protection is designed for normal Grid configuration with fault current provided by a robust utility source
  - Distributed Generation is configured for Grid Following and will separate or “trip” upon loss of Grid Source
  - Stable system grounding is provided by the robust utility source

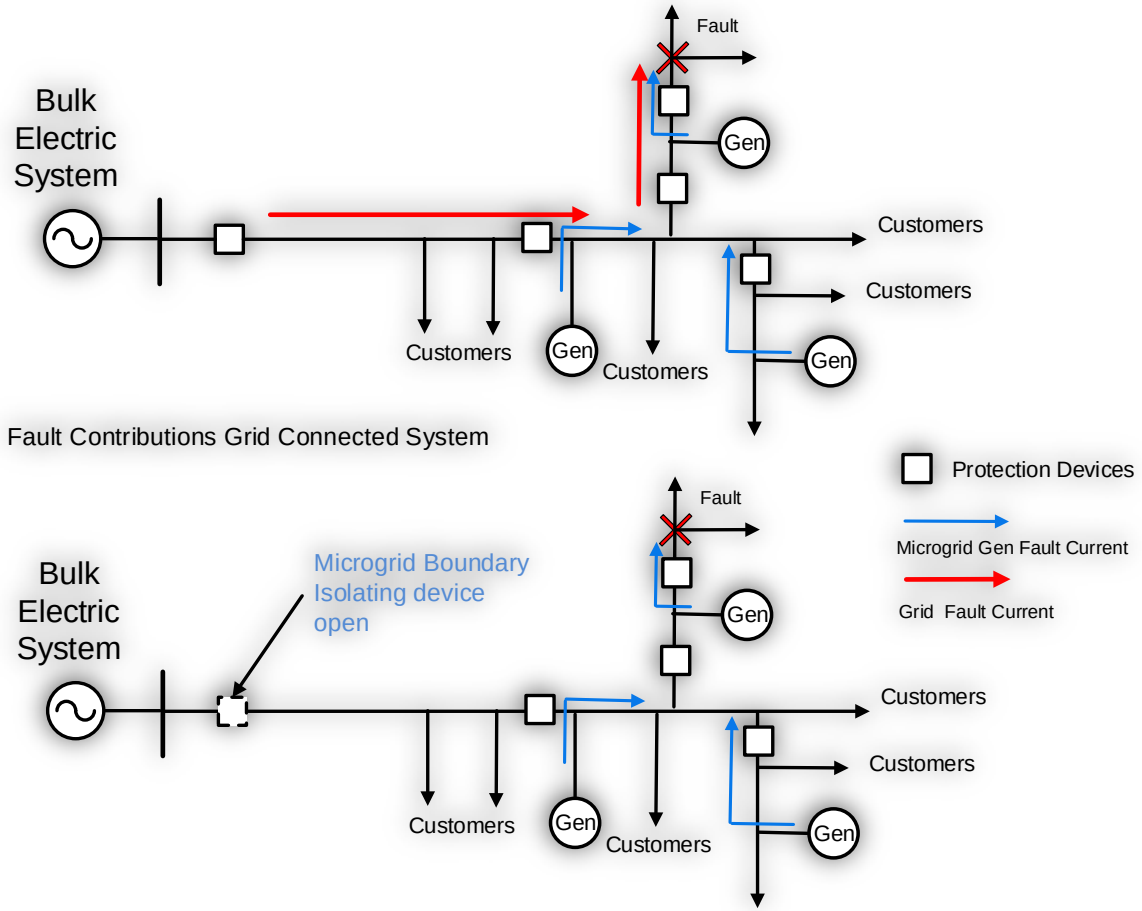
- **Grid Forming – Microgrid Operates in an Islanded State Separate from Utility Grid**
  - Circuit is supplied solely by the islanded generation, resulting in greatly reduced fault currents. Absent a robust utility grid and powered by relatively weak inverter-based generation (solar, batteries, etc.), fault duty is greatly reduced which poses significant challenges for protection schemes to detect faults and operate as intended
  - Protective devices are not traditionally configured to detect the reduced fault currents, so dynamic protection setpoints may be required to ensure utmost safety
  - System grounding likely needs to be supplied by the microgrid due to loss of utility ground source. May need to perform studies to determine the best method for "effective grounding".



# Microgrid Operating Modes

- Example of fault current change between connected and microgrid modes of operation.
  - Top – Grid Following
  - Bottom – Grid Forming
- To provide adequate protection, the "Protection Device" settings need to be studied and modified to account for the change in fault duty.
  - Worst case fault studies need to be performed for each grid forming and grid following case.
- The islanded generation needs to supply adequate fault current to allow clearing of all faults within the microgrid.
  - Generation resource type needs to be studied to determine if sufficient stability can be achieved with proper fault characteristics
- Coordination of protective devices needs to be evaluated in each operating mode.
  - Will determine if a fault affects the entire micro grid or just the faulted section.



# Elements of the MIS

The MIS evaluates the following categories:

1. System Components
2. Controls and Protection
3. Communication and Cybersecurity
4. Agreements and Procedure Documentation

# 1. System Components

**Validate that system components meet utility standards and can be modeled and integrated into utility systems.**

- **Devices and settings** should be known, tested and well documented
  - Including energy resources, controllers, and other protection equipment

- Example **testing tools** to evaluate new devices and settings
  - Power Flow Modeling: Real Time Digital Simulation (RTDS), Cyme
  - Power Hardware in the Loop
  - Control Hardware in the Loop

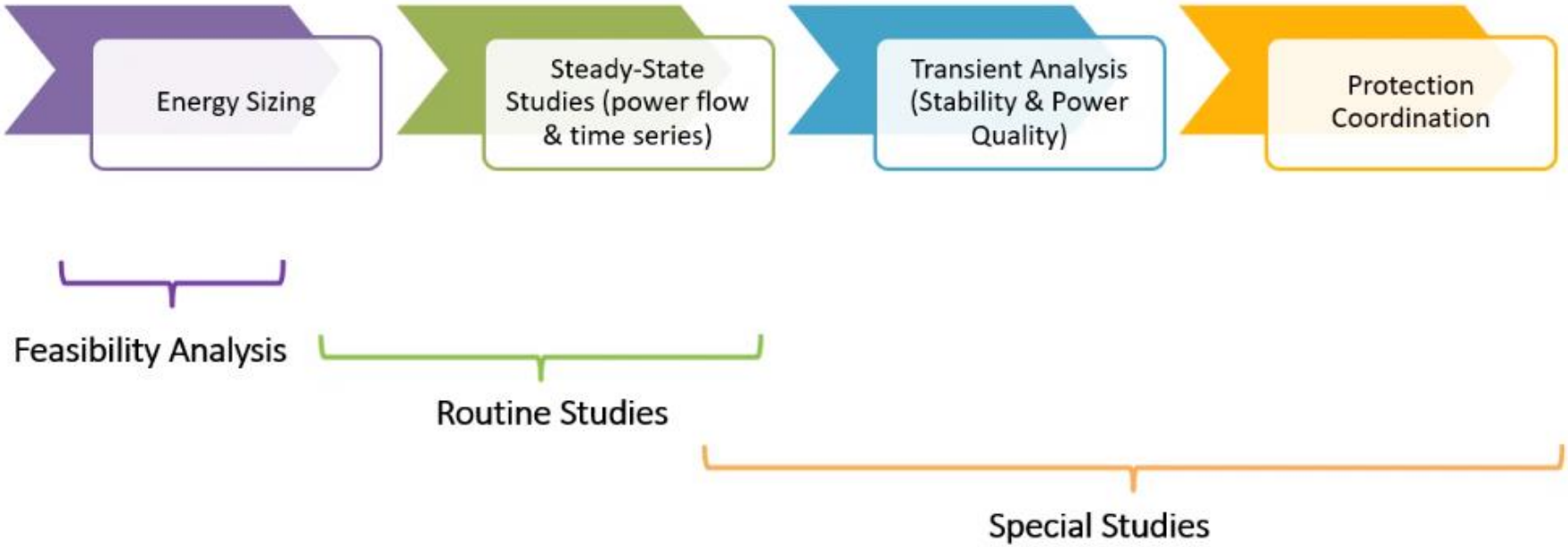
# 2. Controls and Protection

## Validate that control logic and protection settings ensure safe operations.

- Determine operational states in blue-sky and islanded modes
- Evaluate the power flow, fault duty, protection coordination, safe operations under adverse conditions (e.g. PSPS), and black start operations
- Hardware and controls failsafes, and alarm responses

# System, Controls, and Protection Studies

## Example Process



# 3. Communication and Cybersecurity

## Ensure resilient communication and network security with third-parties.

- Determine level of visibility and control needed with PG&E Distribution Control Center (DCC)
- Determine communication pathways and failsafe plans in the event of loss of communication
- Evaluate required cybersecurity protocols

# 4. Agreements and Procedure Documentation

## Encode operating procedures and protocols

- Allocation of costs between PG&E and third parties
- Define the division of responsibilities between parties during islanded operations

# Conclusion

- The microgrid islanding study is the engine that enables the Community Microgrid Enablement Program (CMEP)

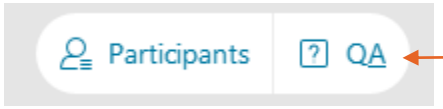
- It ensures operational safety while PG&E meets customers' needs through first-of-its-kind community microgrids

# Q&A

# Q&A and Discussion

## WebEx Tip

### Option 1:

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### Option 2:

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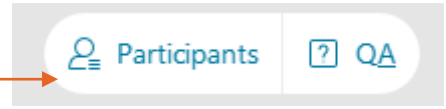


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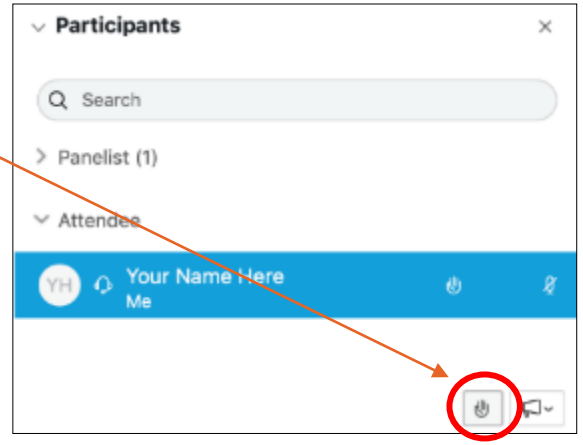
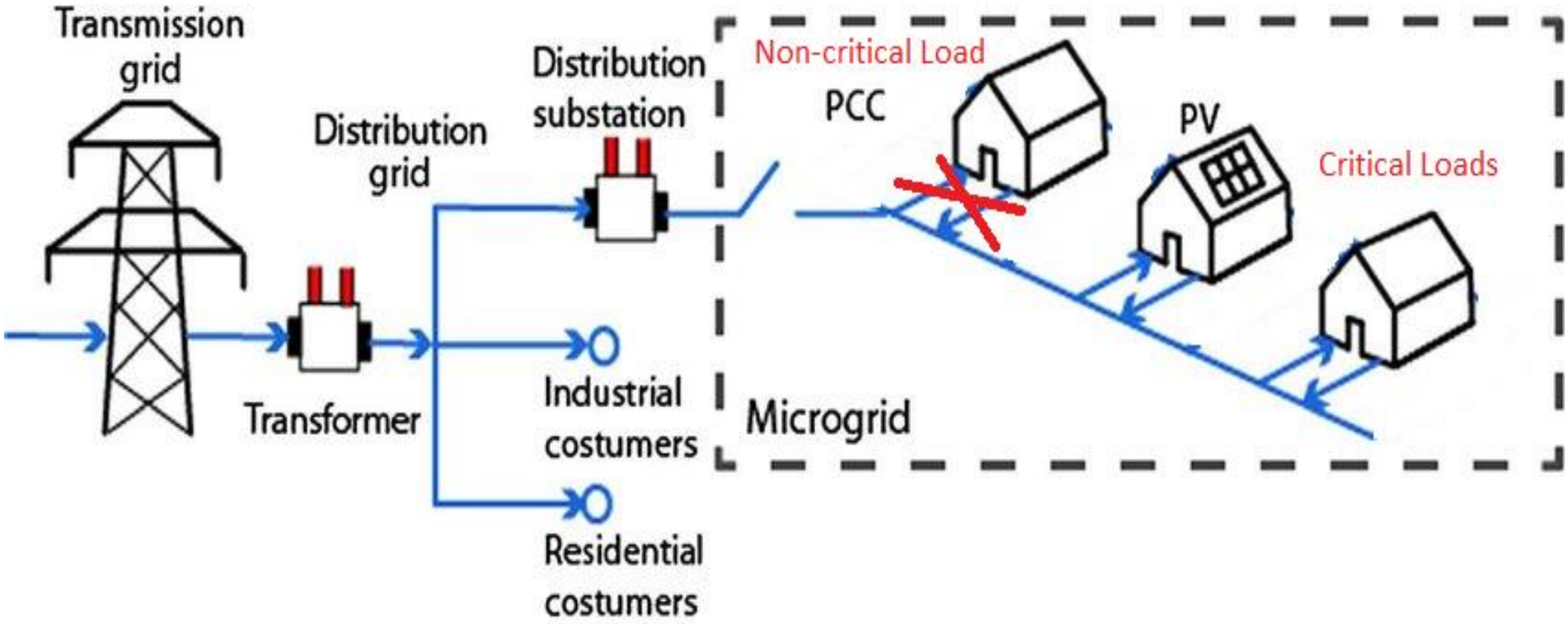


# Selective De-energization within a Microgrid Island

- Potential scenarios:
  - Serve only critical facility loads within island
  - Reduce loads within island to magnitude they can be served with zero-GHG sources
  - Allow for non-participating premise within a multi-property microgrid

# Selective De-energization within a Microgrid Island



# Selective De-energization within a Microgrid Island

- Technical criteria
  - Isolation device that separates individual premise(s) from the microgrid island
    - Premise without self-generation/storage will have outage
  - Unexpected re-connection cannot result in safety risk
    - Is additional unexpected load only (e.g., reduces duration of microgrid) a risk?
  - How robust do communications need to be?

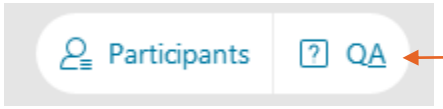
# Selective De-energization within a Microgrid Island

- Unaware of a device intended for this purpose
  - Can existing device be adapted for this purpose?
  - What about remote disconnect in smart meter?
- Are non-utility stakeholders interested in multi-property microgrids that support partial load within the island?
- Do utility stakeholders believe this concept is:
  - Technically feasible?
  - Regulatory feasible?

# Q&A and Discussion

## WebEx Tip

### Option 1:

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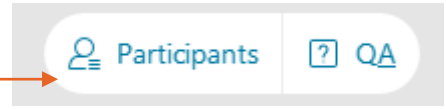


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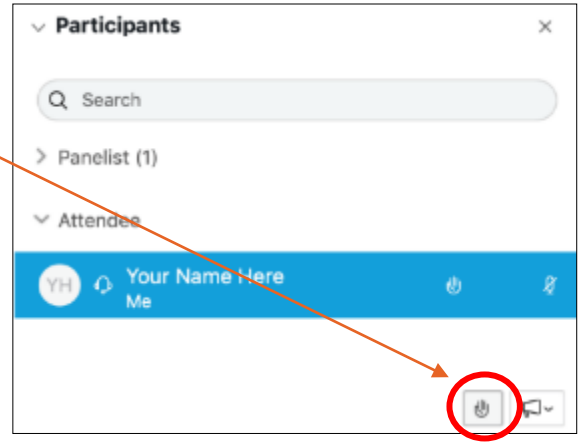

# Closing and Upcoming Meetings

# Upcoming Meetings

- **Thursday, September 9, 2021 (2-4 pm) (tentative)**
  - Presentation by San Diego Gas & Electric – Experience integrating microgrids into their system
  - Presentation by Green Power Institute on historic challenges interconnecting front-of-meter DERs
- **September 23, 2021(afternoon) (tentative)**
  - Potential microgrid controller specifications and requirements
  - Ensuring microgrid interoperability with evolving distribution grid

- Possible these will be pushed into future by a week or two


# California Public Utilities Commission

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https://www.cpuc.ca.gov/resiliencyandmicrogrids/